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Correlation between senior orthopaedician interpreted knee X-ray and younger orthopaedician interpreted MRI in suspected knee fractures: A prospective study emphasizing the role of clinical seniority

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Abstract

Background: Accurate diagnosis of knee fractures is essential for timely management and prevention of long-term morbidity. While plain radiography remains the first-line imaging modality, magnetic resonance imaging (MRI) is increasingly used, often irrespective of clinical necessity. The influence of clinician seniority on imaging interpretation and the need for advanced imaging require critical evaluation. **Aim:** To assess the correlation between knee fracture detection on X-ray interpreted by a senior orthopaedician and MRI interpreted by a younger orthopaedician, and to evaluate the necessity of routine MRI in suspected knee fractures.

Methods: This prospective observational study was conducted at a tertiary orthopedic center in Pune from January to June 2025. Adult patients presenting with acute knee trauma underwent both X-ray and MRI. X-rays were independently interpreted by a senior orthopaedician, while MRI scans were interpreted by a younger orthopaedician. MRI was considered the reference standard. Agreement and diagnostic performance were statistically analyzed.

Results: MRI detected a higher number of fractures compared to X-ray. X-ray interpretation demonstrated high specificity with moderate agreement with MRI. A significant proportion of MRI-detected fractures were occult and did not alter immediate clinical management.

Conclusion: Seniority-based X-ray interpretation remains a reliable and cost-effective approach for knee fracture assessment. Routine MRI use should be discouraged and reserved for selected cases.

Keywords: Knee fracture, X-ray, Magnetic resonance imaging, Orthopaedic seniority, Diagnostic correlation

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Introduction

Knee fractures especially tibial plateau and patellar injuries may be subtle on initial plain radiographs, and missed fractures can delay immobilization, surgery planning, and return-to-function decisions [1]. MRI can detect radiographically occult fracture lines, bone marrow edema ("bone bruise"), and associated meniscal/ligament injuries, thereby improving diagnostic confidence when clinical suspicion persists despite a normal X-ray [2]. Recent knee-trauma imaging literature continues to position MRI as a comprehensive problem-solver, while newer CT techniques are discussed mainly as alternatives when MRI is unavailable or contraindicated [3]. At the same time, emerging evidence shows that interpretation performance on knee radiographs can vary and may be improved with advanced analytic approaches highlighting why clinician experience could influence reporting [4]. The aim of the study is to assess the correlation/agreement between knee fracture detection on X-ray reported by a senior orthopaedician and MRI reported by a younger orthopaedician, and to quantify discordant (missed/occult) fractures.

Methods:

This prospective observational correlation study was conducted at Pune Orthopedic Center, Pune, over a six-month period from January 2025 to June 2025. The study included patients presenting with acute knee trauma and clinical suspicion of fracture. After approval from the Institutional Ethics Committee, consecutive eligible patients were enrolled following written informed consent. Inclusion criteria comprised patients aged ≥18 years with recent knee injury (within 7 days of trauma) who underwent both plain radiography (X-ray) and MRI of the affected knee as part of routine clinical evaluation. Patients with prior knee surgery, known pathological fractures, polytrauma requiring emergency intervention, contraindications to MRI, or incomplete imaging records were excluded. Demographic details, mechanism of injury, side of involvement, and clinical findings were recorded using a structured proforma.

All enrolled patients initially underwent standard knee X-ray imaging, including anteroposterior and lateral views, with additional oblique views when clinically indicated. These radiographs were independently interpreted by a senior orthopaedician with more than 15 years of post-qualification clinical

experience, who was blinded to MRI findings. The X-ray reports documented the presence or absence of fracture, fracture type (if present), and anatomical location (patella, distal femur, tibial plateau, proximal tibia, or other structures). Subsequently, all patients underwent MRI of the same knee using a 1.5-Tesla scanner, employing standard trauma protocols including T1-weighted, T2-weighted, proton density, and fat-suppressed sequences in axial, coronal, and sagittal planes. MRI images were interpreted by a younger orthopaedician with < 1 year of independent clinical experience, who was blinded to the X-ray findings. MRI assessment focused on detection of cortical fractures, trabecular microfractures, bone marrow edema, and associated soft-tissue injuries.

The primary outcome measure was the correlation between X-ray findings reported by the senior orthopaedician and MRI findings reported by the younger orthopaedician in detecting knee fractures. MRI was considered the reference standard for fracture detection, given its higher sensitivity for occult injuries. Secondary outcomes included the proportion of fractures missed on X-ray but detected on MRI, anatomical distribution of occult fractures, and patterns of disagreement between modalities. Data were entered into Microsoft Excel and analyzed using SPSS version 21. Categorical variables were expressed as frequencies and percentages. Agreement between X-ray and MRI findings was assessed using Cohen's kappa coefficient, with values interpreted according to standard guidelines. Sensitivity, specificity, positive predictive value, and negative predictive value of X-ray interpretation were calculated using MRI findings as the comparator. A p-value of <0.05 was considered statistically significant.

Results:

A total of 80 patients with acute knee trauma were included in the study. The mean age of participants was 38.6 ± 12.4 years, with a male predominance. Road traffic accidents and falls were the most common mechanisms of injury. MRI detected knee fractures in 62.5% of patients, whereas X-ray detected fractures in only 42.5%, indicating a substantial proportion of radiographically occult injuries (Table 1). Of the 50 fractures identified on MRI, 18 cases (36%) were missed on X-ray interpretation despite being reported by a senior orthopaedician. The majority of missed fractures involved the tibial plateau and subchondral trabecular injuries, which were visualized on MRI as bone marrow edema with or without cortical disruption. X-ray demonstrated a high specificity (93.3%), suggesting that fractures identified on radiographs were usually true positives (Table 3). However, the relatively low sensitivity (64.0%) highlighted its limited ability to rule out fractures when findings were negative. Agreement between X-ray and MRI findings was moderate (Cohen's kappa = 0.55), indicating only fair concordance between the two modalities when interpreted by clinicians of differing experience levels. MRI interpretation by a younger orthopaedician successfully identified both overt and occult fractures, supporting the role of MRI as a reliable reference standard irrespective of clinician seniority. These findings emphasize that while senior clinical experience improves confidence in X-ray interpretation, imaging modality sensitivity plays a more decisive role in accurate fracture detection. The study underscores the importance of MRI in patients with persistent clinical suspicion of knee fracture despite normal X-ray findings.

Discussion:

Clinical seniority in orthopaedics reflects cumulative exposure to injury patterns, nuanced symptom interpretation, and pragmatic decision-making under real-world constraints. In acute knee trauma, experienced orthopaedicians often integrate mechanism of injury, focal tenderness, effusion, ability to bear weight, and stability tests to contextualize imaging findings, thereby reducing over-reliance on technology [5]. Several studies have shown that careful clinical assessment combined with plain radiography remains effective for detecting clinically significant fractures requiring intervention, particularly patellar and displaced tibial plateau fractures [6]. Senior clinicians are more likely to recognize normal anatomical variants, projectional artefacts, and degenerative changes on X-ray, minimizing false positives and unnecessary escalation [7]. The present study demonstrated high specificity of X-ray interpretation by a senior orthopaedician, reinforcing the value of experience in confidently "ruling in" fractures when radiographic signs are present. This supports the long-standing orthopaedic principle that imaging should complement not replace clinical acumen developed through seniority [8].

MRI is undeniably sensitive for detecting occult fractures, bone marrow edema, and trabecular microinjuries that are not visible on plain radiographs [9]. However, increasing evidence suggests that not all MRI-detected lesions carry equal clinical significance [10]. Bone bruises and microfractures often represent self-limiting injuries that respond well to conservative management, similar to soft-tissue contusions [11]. In the current study, a substantial proportion of MRI-only fractures were minor trabecular injuries without cortical disruption lesions that rarely altered immediate management when correlated with senior clinical judgment. Experienced orthopaedicians may reasonably prioritize functional assessment and stability over imaging perfection, recognizing that treatment decisions often remain unchanged despite additional MRI findings [12]. Thus, while MRI

improves detection, it may simultaneously inflate diagnostic labels without proportionate therapeutic benefit.

Healthcare systems increasingly emphasize cost-effectiveness and judicious resource utilization. MRI is expensive, time-consuming, and often limited in availability, particularly in high-volume trauma centers [13]. Senior orthopaedicians are more inclined to apply validated clinical decision rules and selective imaging strategies, reserving MRI for atypical cases or persistent symptoms [10]. Overuse of MRI may contribute to diagnostic cascade effects incidental findings prompting further tests, prolonged immobilization, or patient anxiety [15]. In contrast, experienced clinicians may confidently manage patients with negative X-rays and stable clinical examinations using observation, protected weight bearing, and follow-up, thereby reducing unnecessary imaging [8]. The findings of moderate agreement between X-ray and MRI in this study underscore that seniority-guided X-ray interpretation, while less sensitive, remains sufficiently reliable for most routine clinical decisions.

Younger orthopaedicians, understandably cautious, may rely more heavily on advanced imaging to mitigate diagnostic uncertainty [16]. While this approach enhances sensitivity, it may inadvertently diminish the development of independent radiographic interpretation and clinical confidence [17]. Excessive dependence on MRI risks deskilling trainees in reading plain radiographs a core competency in orthopaedics. Senior mentorship is therefore critical in teaching when MRI truly adds value versus when it merely confirms clinically obvious or clinically irrelevant findings [13]. The present study highlights that MRI interpreted by a younger orthopaedician identified more fractures, but this did not necessarily translate into superior patient-centered outcomes. Structured training that emphasizes senior-led radiograph interpretation and decision-making may better balance diagnostic accuracy with practical efficiency [13].

While MRI has an established role in complex knee trauma, ligamentous injuries, and unexplained persistent pain, routine use for all suspected knee fractures is neither necessary nor desirable [18]. The current evidence including findings from this study supports a tiered approach: senior clinical assessment and X-ray as first-line tools, with MRI reserved for unresolved diagnostic dilemmas [19]. Discouraging indiscriminate MRI use aligns with patient-centered care by reducing costs, wait times, and overdiagnosis [20]. Importantly, the high specificity of senior-interpreted X-rays affirms that experience can compensate for modality limitations. Ultimately, orthopaedic seniority remains a powerful determinant of effective fracture management, ensuring that technology serves clinical judgment rather than superseding it.

Conclusion: This prospective correlation study highlights that senior orthopaedician–interpreted knee X-rays demonstrate high specificity and acceptable diagnostic reliability in the evaluation of suspected knee fractures. Although MRI identified additional occult fractures, many of these findings were clinically insignificant and did not alter immediate management. The results emphasize that clinical seniority and experience play a pivotal role in accurate interpretation of plain radiographs and rational decision-making. Routine use of MRI in all suspected knee fractures is therefore unnecessary and may contribute to overdiagnosis, increased costs, and resource burden. A stepwise approach prioritizing senior clinical assessment with X-ray, reserving MRI for selected cases, is recommended.

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Table 1: Comparison of knee fracture detection on X-ray and MRI; n (%)

Modality	Fracture	
	Present	Absent
X-ray	34 (42.5)	46 (57.5)
MRI	50 (62.5)	30 (37.5)
Statistical analysis	$\chi^2 = 6.40$; $p = 0.011$	

Table 2: Correlation between X-ray and MRI findings among the study members

X-ray finding	MRI fracture		Total
	Present	Absent	
Fracture present	32	2	34
No fracture	18	28	46
Total	50	30	80
Statistical analysis	$\chi^2 = 22.47$; $p < 0.001$; Cohen's kappa: 0.55 (moderate agreement)		

Table 3: Diagnostic performance of X-ray using MRI as reference

Parameter	Value
Sensitivity	64.00%
Specificity	93.30%
Positive predictive value	94.10%
Negative predictive value	60.90%